

VIRGINIA GIS REFERENCE BOOK

General Application Name: Police

Product / Service / Function Name: Crime Prevention

P/S/F Description:

Crime Prevention strategies often employ relationships between law enforcement agencies and citizen-based organizations. These community organizations are commonly referred to as Neighborhood Watch Groups (NWGs) and take on the responsibility of augmenting standard community policing efforts by organizing daily/nightly walks, business owner and/or citizen newsletters and informal communications of basic intelligence to the local law enforcement agency. To foster this extra support, to implement community oriented policing techniques and to improve the quality of life within their jurisdiction law enforcement agencies often facilitate the organization of NWGs.

Law enforcement agencies and NWGs typically establish goals to guide their efforts and assist in evaluating the effectiveness of these initiatives:

1. Reduce the fear of crime
2. Reduce the actual number of calls for service
3. Increase police-community interaction and relations
4. Utilize the NWGs to identify hotspots of criminal activity unknown to law enforcement
5. Increase the effectiveness of the NWGs
6. Provide NWGs with information to guide their activities
7. Develop and implement tools enabling NWGs to generate their own reports and maps of criminal activity.

Product / Service / Function

1. Spatial Data:

Minimum Requirements

General Description	Data Layer
Law Enforcement Data	Incident Locations
Natural Features	Parks
	Open Water
Transportation	Street Centerlines
Socio-Political Data	Municipal Boundary
	Police Zone Boundaries
	Fire Stations
	Schools
	Hospitals

Optional Enhancements

General Description	Data Layer
Law Enforcement Data	E911 Call Locations/Calls for Services (CFS)**
Land Base / Planimetric	Tax Parcels

Data	
Natural Features	100-Year Floodplain
Transportation	Street Double Lines (Right of Way)
	Public Transit Routes
	Railroads
Socio-Political Data	Zip Code Boundaries
	Census Block Groups
	Convenience Store & Retail Centers
	Bars
	Social Service Locations
	Prisons
	Neighborhoods & Subdivisions
Other Data	Digital Orthophotography

****Note:** The local law enforcement agency must determine the level of information that is provided to the public, especially when dealing with the location of an incident. The law enforcement agency must weigh the Neighborhood Watch Group's right/need to know with the right to privacy of a crime victim and suspect. Therefore, 911 calls for service and incidents are often aggregated into larger groups, such as a block, zip code, police-delineated zone or census block group. This strategy protects the specific information about an incident and provides the NWG with a summary or total number of events for that area.

2. Attribute Data:

Minimum Requirements

General Description	Field Name
CFS	Unique CFS Identification Number
	Date Call Received
	Time Call Received
	Address or Block Origin
	Call Type and Category
Incident Data	Unique Incident Identification Number
	Occurrence Date
	Occurrence Time
	Address or Block
	UCR Code
	Crime Type and Category
	Patrol Zone
Arrest Data	Unique Personal Identification Number
	Arrest Date
	Arrest Time
	Sex
	Age
	Race
	Charge Type and Category
	Arrest Address
	Related Incident Number

Optional Enhancements

General Description	Field Name
Incident Data	Premise Code
	Day Code
	Hour
	Business
	Additional Victims
	Modus Operandi
	Drugs
	Domestic Abuse
Arrest Data	Related Incident Number

3. Data Acquisition Options

There are many sources for spatial data that a crime prevention GIS application requires. As previously mentioned, digital CFS data can be obtained from the 911-dispatch center and digital incident data can be obtained from the local law enforcement agency's Records Management System (RMS). An RMS can be as simple as a file cabinet full of the police response reports collected by an officer at the scene of an incident. An RMS is, however, most typically a digital database (ex. MS Access, SQL Server, Oracle, mainframe flat-file) that is used to enter these paper reports into a computer for storage. The RMS can then serve as more than a reservoir of incident reports, it can be utilized to generate summary reports, used for advanced statistical analysis, or used as the 'base' from which 'data' is extracted for mapping. The CFS/incident data can either be extracted from the 911 database/incident RMS on a regularly scheduled basis and placed into a data warehouse, or the crime analysis and mapping system can link directly to these databases. The mapping system is then used to geocode, or spatially locate, each event using a street centerline file or a parcels data layer. A street centerline data layer represents each street in a community by a single line that has attached to it its address range. Tax parcels represent a property by a polygon that has information attached to it pertaining to ownership, address, and other assessment data.

In either case, the address of an incident record is matched to a parcel or location along the street centerline, and a point feature is created to represent that event. Tax parcels are typically maintained at the county level, and are often distributed free of charge to local municipalities. Street centerline data layers of varying qualities can be obtained by a number of vendors. The market is relatively competitive, and prices will vary with quality of the data. Relevant vendors that provide this kind of spatial data on a regional and national scale include: NAVTECH (www.navtech.com), GDT (www.geographic.com), and TeleAtlas (www.teleatlas.com). Geocoding can also be used to create other data layers that use single addresses, such as fire stations, schools, hospitals, bars, prisons, convenience store/retails centers, etc.

Other spatial data layers can be obtained through the Internet from various government sources. Municipal boundaries, zip code, Census tract, and block group boundaries and Census attribute data can be obtained in digital format through the U.S. Census Bureau (www.census.gov). Floodplains can be obtained through the FEMA Web site (www.fema.com).

Land base and planimetric data are typically generated at the county level. County staff may create this data themselves or contract the project out to a consulting firm. This data often includes tax parcels, parks, open water, street double lines (Right of Way), and railroads.

The VBMP orthophotos should be an integral component of a crime prevention application. The orthophotos will give watch groups and police authorities a “bird’s eye view” of the neighborhood, which can aid in organizing the efforts of an NWG.

4. Data Conflation Options

Data conflation is a process by which two digital data layers, usually of the same area at different points in time, or two different data layers of the same area, are geographically “corrected” through geometrical and rotational transformations so that the different layers can be overlaid on one another. Also called “rubber-sheeting,” this process allows a technician to adjust the coordinates of all features on a data layer to provide a more accurate match between known locations and a few data points within the base data set. A good base layer to use for data conflation is the VBMP orthophotos since many features can be seen or interpreted. The need and processes for conflation varies between sets of data, users, and feature types. Any dataset that is updated independently by different departments can be consolidated through conflation. Within most local governments, individual departments are responsible for maintaining specific datasets within their expertise; therefore, conflation is not often necessary. Often, reprojecting the data into a different coordinate system will take care of the misalignment of different data sets. Most industry-standard GIS software has the ability to perform data conflation. Commonly conflated data layers include: parcels, street centerlines, census boundaries, law enforcement boundaries, and any layer that was built using either the parcels or street centerlines.

Each data layer used for crime analysis and mapping should use the Virginia Base Mapping Project orthophotography for the conflation process. This is vital for data consistency across the state, and facilitates data sharing across jurisdictional boundaries. For example, CFS summaries and street centerlines need to be in the same projection in order to perform any type of geographic analysis.

5. GUI / Programming Options:

With projects involving NWGs, the law enforcement agency most often develops and maintains the infrastructure required to operate and deploy these applications. However, NWGs need to be an integral part of the development effort to ensure a user-friendly and worthwhile product. There are many options for developers of a crime prevention application. The following are three approaches:

- Standard GIS desktop application that can be customized to the user’s needs
- Purchase existing commercial software
- Hiring a consultant to develop a custom system from scratch.

Using a standard GIS application often requires a significant amount of training and customization. Whereas the initial cost may be low, the time invested in learning these solutions may generally increase the overall expense of implementation. Standard GIS software packages deliver more robust data integration, analysis, and cartographic capabilities than do other crime analysis applications. They have a greater user support infrastructure that allows users to overcome problems quickly. Options for using an existing, industry-standard GIS software application that can be customized for crime prevention include those listed in the following table:

Standard GIS Software Vendors

Vendor	Software	Add-ons	Web Address
ESRI	ArcView 3.x	Crime Analysis Extension	www.esri.com
ESRI	ArcGIS 8.x		www.esri.com
MapInfo	Professional v7.0	CrimeInfo Extension	www.mapinfo.com
Intergraph	GeoMedia 5		www.intergraph.com/gis
Autodesk	Map 5.0		www.autodesk.com

There are an increasing number of vendors developing and implementing crime prevention software. These products may often cost more than standard GIS solutions because of the customization that is required to fit the application into the agency's business practices and/or connect to its RMS. The advantage is that a tailored law enforcement application provides just the functionality that is needed, decreasing the overall application overhead common to industry-standard GIS software. Options for using an existing, commercial crime prevention application include those listed in the following table:

Commercial Software

Vendor	Software	Web Address
GeoDecisions	GeoCAMS	www.geodecisions.com
Omega Group	CrimeView	www.theomegagroup.com
NIJ/ESRI	Community Policing Beat Book	www.esri.com/industries/lawenforce/beatbook.html

The final option for developing and implementing a GIS-based crime prevention application is to contract a consultant. This option makes certain that a product will fulfill an agency's requirements. Unlike the first option, which requires the law enforcement agency to modify its own process/technology to fit the system, the system fits existing business practices. A consultant will be able to develop an application that works with the wide range of 911 databases and RMSs that currently exist within the state. Also, training and follow-up user support is often provided at a much more substantial level than with other options.

Basic functions for a crime prevention application would include simple contextual map display and printing, as well as incident querying and mapping. More advanced NWG users are provided with advanced spatial and temporal analysis techniques, a standard and automated map production process, and graphic tools to facilitate the creation of NWG patrol strategies.

Potential products of a crime prevention application include the following items:

- A set of basic crime maps, as well as a composite crime map based on a set of incidents recorded over a specified time period.
- A modifiable incident list that allows users to define a crime and view a detailed table of all recorded incidents of that particular type over a specified time period.
- A top 10 listing of the most frequent incidents recorded over a specified time period.

- Charts that display the temporal distribution of user-defined incidents over a specified time period.
- A set of trend maps that color code areas of the jurisdiction according to their increase or decrease in percentage of incidents of a particular type over a specified time period.

6. Internet Functionality and Options:

The Internet has proven itself as a viable solution for law enforcement agencies to centralize the maintenance and management of services and data, while providing information to a wide-variety of constituencies, like NWGs. As more law enforcement agencies are implementing Web-based solutions, they are finding that the Internet does not require them to change the nature of an application or its usefulness. Using the Internet, software can be easily updated, and users gain greater accessibility to the applications and information they need for their specific tasks through simple, user-friendly interfaces.

A crime prevention application may not be suitable for public viewing on the Internet, due to the confidential nature of the data and NWG strategies. However, NWGs may want to summarize statistics with maps or show crime reduction maps in an interactive Web GIS application. GIS software vendors have products that can be customized in-house or by a consultant to provide distributed applications on the Internet, over an intranet or via wireless network. Basic tools such as zooming, panning and identifying are most often provided to the user for map/data manipulation.

GIS Internet Solutions

Vendor	Internet Software	Web Address
ESRI	ArcIMS	www.esri.com/software/arcims
MapInfo	MapXtreme	www.mapinfo.com
Intergraph	GeoMedia WebMap	www.intergraph.com/gis/gmwm
Autodesk	MapGuide	www.autodesk.com

7. Technical Requirements:

Minimum Technical Requirements

At its most basic level, a NWG crime prevention application can be used on a single, stand-alone workstation. This workstation would have a hard drive that stores all of the spatial data layers, as well as a database containing a copy of all of the incident records for the law enforcement agency. A typical workstation running off-the-shelf software should have the following minimum specifications:

Processor: Pentium 3, 450 MHz
 RAM: 128MB SDRAM at 133MHz
 Hard Disk: 20GB (min.)
 Monitor 1: 19"
 Floppy Drive: 3.5"
 CD-ROM: 12x/8x/32x CD drive
 Modem: 56K
 OS: Windows 2000/NT/XP
 Office: Windows 2000 Professional

Printer: 8x11 office-grade color printer

Optimum Technical Requirements:

A more complex NWG crime prevention system may require multiple components, including servers and desktop workstations. For either a client-server or a Web-based application, the system should rely on a fairly robust server computer and high-end workstations. Example specifications of the necessary equipment are listed below:

Server

Processor: Min. 2x Processors, 1.7 GHz, 512K cache
RAM: Min. 2x 512MB RIMMS
Hard Disk: Min. 2x 80GB +RAID
Monitor 1: 19"
Floppy Drive: 3.5"
CD-ROM: 12x/8x/32x CD drive
Modem: 56K
Network Card: 10/100 mbps

Workstation

Processor: Pentium 4, 1.5 GHz
RAM: 512MB SDRAM at 133MHz
Hard Disk: 20GB (min.)
Monitor 1: 19"
Monitor 2: 17"
Floppy Drive: 3.5"
CD-ROM: 12x/8x/32x CD-RW drive
Modem: 56K
Network Card: 10/100 mbps
OS: Windows 2000/NT/XP
Office: Windows 2000 Professional

Other Components

Printer: 8x11 office-grade color printer and 8x11 production b/w printer
Plotter: HP DesignJet 1055CM
Tape Backup: Tape Library Server
UPS: APC 1400 (or other similar)
Scanner: 11x17
Handheld: Compaq IPAQ
Network: T1

8. Administrative/Management Requirements

At the beginning of the project, the assigned project manager of the local law enforcement agency should consider completing some, if not all of the following tasks that relate to the administrative requirements of a NWG crime prevention application:

- Determine, with or without the assistance of a consultant hired to develop the system, the preliminary vision and goals of the project.
- Determine the stakeholders (e.g. NWGs and community organizations, community policing units, police administrative units) of the project within their own jurisdiction and with government entities that they interact with.

- Coordinate an initial stakeholders meeting where the vision and goals of the project are expressed and the background of GIS technology is described, if needed.
- Coordinate with other municipal agencies for data sharing provisions.
- Determine a mechanism of communication to keep the stakeholders aware of the progress of the project.
- Develop a basic understanding of the available precedents in their region/state and research the available technologies that can be applied to their project.

Upon project completion, a simple desktop crime prevention application will require very little administrative support. Administrative tasks may include loading or upgrading new versions of the software or patches, providing for constant data flow from the 911 dispatch center or incident RMS, and maintaining yearly support contracts on the hardware and software. However, once the system becomes distributed, there are various other management requirements that need to be fulfilled on a weekly or monthly basis.

At the point where the system grows beyond single desktop users, a devoted administrator or system manager needs to be established. This is essential for the following reasons:

- The system will now be interfacing with other technology systems already in place. Therefore, someone needs to maintain contact with the technology personnel that maintain these systems.
- The manager on the law enforcement side needs to put into place semi-annual training schedules to maintain user knowledge of the system.
- Funding will undoubtedly be required to either maintain the system long-term, or continue to expand the system, which requires funding research and applications for grants.
- A crime prevention application will only succeed when it is implemented on a weekly or biweekly basis with NWGs. If they wish to be successful, the local law enforcement agency should proceed with the project in a rigorous fashion to demonstrate the benefits of this type of analysis and planning.

9. Costs:

Hardware	Typical Unit Cost
Minimum Workstation	\$2,000
Optimum Workstation	\$3,200
Laptop	\$2,400
Web/FTP Server	\$8,500
Database Server	\$12,000
Data Warehouse Server	\$18,000
Backup Server	\$5,800
Printer (8x11 color)	\$700
Printer (8x11 b/w production)	\$2,000
Plotter	\$12,000
Tape Library	\$5,000
UPS	\$700
Scanner	\$1,500
Handheld	\$300-\$700

Software (all prices included license)	Typical Unit Cost
Standard GIS desktop software	\$700-\$10,000
Desktop vendor crime analysis and mapping application	\$2,000-\$6,000
Customized desktop vendor solution	\$5,000-\$15,000
Web-based vendor application	\$15,000-\$25,000
Customized web-based vendor solution	\$20,000-\$60,000

Miscellaneous	Typical Unit Cost
Training – focused vendor crime mapping training (per person)	\$700-\$1,000
Training – general GIS	\$700-\$1,200
Licensing-desktop	\$100-\$500
Licensing-webapp (1st CPU)	\$7,500-\$12,000
Maintenance (per year)	\$8,000-\$15,000

10. Standards / Guidelines Summary

- Always maintain a unique identification number with every incident, spatial feature, and event recorded within the system.
- Standardize street naming conventions to make certain of proper geocoding.
- If there are multiple streets with the same name (e.g., Main St.) then standardize additional fields, such as borough name or zip code, that are collected to differentiate the streets.
- Create standard Common Place-name file for ease in data entry by NWG staff.

McDonald's	236 Johnson St
Grant Statue	14 th St. & Willits St
Central Park	1500 Warrington Rd
The Pit	6550 Templeton Ln
K&A	Kensington Ave & Allegheny Ave

- Collect zip code for all incidents. This facilitates cross-jurisdictional information sharing.
- Standardize use of Uniform Crime Reporting codes statewide.
- Standardize date and time conventions.
- Develop a detailed Quality Assurance/Quality Control (QA/QC) procedure for reviewing the accuracy of the GIS data and its attributes.
- Maintain data in the VBMP standard coordinate system (Virginia State Plane, NAD 83, Survey Feet).
- Create metadata (standard information about GIS data) for each data layer. Metadata tracks the date, origin, coordinate system, and other such information for data layers.

11. Startup Procedures/Steps

There should be a minimum of eight steps involved with a crime prevention application after funding is in place to support the project. The steps can be performed in-house or by a consulting team. They include a needs assessment, functional requirements documentation, data development, system development and testing, installation and testing, user training, planning for future development, and ongoing technical support.

The first task is to complete a detailed Needs Assessment. This process gathers information regarding existing operational procedures, hardware and software, crime data, and personnel

needs. There should be a small working group of law enforcement personnel or a community service officer appointed to facilitate this process at the outset. This is the person or group that organizes the needs assessment and should schedule interviews of key individuals throughout the law enforcement agency and NWGs to obtain a comprehensive view of the agency's operations, as well as where GIS might improve them. Meetings should be held with NWGs to determine what problems are present, problem-solving initiatives the group can define to overcome these issues, and any information that would be useful to the community groups in supporting their problem-solving initiatives. Problem solving groups made up of citizens and a law enforcement representative should be formed to focus their attention on individual issues. Basic GIS concepts should be discussed and illustrated to all groups that have little prior understanding of GIS or crime mapping.

A comprehensive Needs Assessment should then be compiled from the results of the interviews. This document explains the various requirements for a crime prevention application in the following areas: personnel needs, spatial data development needs, tabular/incident data development needs, applicable spatial and temporal crime analysis techniques, basic system requirements including preliminary, general hardware and software recommendations, and training needs.

The second task is to develop a functional requirements document for the proposed system. This document should describe, as completely as possible, all of the technology and functionality that is to be included in the crime prevention application. This document is used by the law enforcement agency, the NWGs and their consultant as the blueprint for the application and/or system. It should include the following:

- Hardware specifications
- Software purchases
- Detailed descriptions of work-flow, and examples of the graphic user interfaces
- Describe each tool that is part of that graphic user interface, and its functionality
- Describe how data would flow between the different databases and data warehouses, if applicable
- Describe the redundant security measures that will be put in place to make certain of data integrity and confidentiality, when applicable
- Analytical techniques that the application/system provides the user for queries and analysis
- Describe each of the potential products (reports, maps, charts, summary tables) that the user will be able to generate within the system

The third task should be to compile or develop a law-enforcement-specific spatial data set that can be used by the crime prevention application. Data can be gathered from a number of online sources, as well as county departments. The data layers gathered and maintained should match at least the minimum list provided in Section 1 of this document. At this point, the method of data collection and attributes collected pertaining to an incident should be studied and modified as needed. This might require changes to the agency's RMS. If changes are warranted, it will be worthwhile in the long run to compile additional information for analysis.

On completion and acceptance of the functional requirements document and the development of the spatial and attribute data, the system development and test phase can begin. During this time, the application will be customized as it was outlined in the functional requirements phase. The law enforcement agency and the NWGs should require periodic reviews of the application at

particular milestones, such as 50% and 75% completion. This will make certain that problems with the application will be recognized early in the development process, and that the law enforcement agency and the NWGs remain a part of the development process throughout the project timeline.

User training commences once the application reaches 100% completion and is fully documented. Different levels of tutorials and system documentation should be developed depending on the hierarchy of users. Time should be spent at this stage of the project with each potential user of the system to make certain that the proper education occurs. Training should be done through lessons that use real-life examples of system application. This strategy greatly enhances users' ability to apply the functionality to their jobs.

The next phase of the project should include a document that describes a future plan for wider system development. This document accomplishes two goals. The future plan gives the local government agency ideas on how the system might grow to assist other facets of its business practices. Secondly, it provides the agency with a ready-made grant proposal for applying for potential funding sources.

The next phase of the project should include post implementation studies performed by the law enforcement agency or the consultant who developed the system. These studies should be performed on a semi-annual basis to determine the effectiveness of the system, as well as to identify potential modifications to the system. Some of the questions that should be asked during this study include:

- Are the NWGs' interest in the system increasing or decreasing?
- How often is the system being used over the course of a week or month?
- Are there enough personnel resources at the NWGs to effectively utilize the system?
- Has the system helped the NWG problem solving groups overcome issues they have identified in their communities?
- Has the relationship and communication between the law enforcement agency and the community gotten better or worse?
- Has the system provided the necessary information and support for other related community initiatives (anti-graffiti projects, street-lighting projects, etc.).
- How has the perception of quality of life gotten better or worse during the period of time from the last study?
- Has the system affected the number of calls for service or the number of incidents recorded?
- Are there different use patterns between NWGs?
- Has the system had an impact on citizen mobilization?

The final phase of a successful crime prevention application is ongoing technical support. The law enforcement agency should always include this contingency within its cost estimates of a project for a minimum of three months after a system has been put into place. No matter how effective an application appears, problems and system changes inevitably impact the functionality of a system.

12. Estimated time line and/or implementation (stand alone) schedule:

Phase	Duration
RFP/Contract process (construction, posting, proposal acceptance,	4 months - 1 year

review, award of contract)	
Needs Assessment	1 month
Functional Requirements	1-2 months
Data Development	2-3 months
System Development and Testing	2-4 months
Installation and Testing	1 month
User Training	½ month
Post Implementation Study	On going
Ongoing Support	3 months

13. Best Practice Examples in Virginia

Fairfax County
Police Department
4100 Chain Bridge Road
Fairfax, VA 22030
703-246-2195
<http://www.co.fairfax.va.us/ps/police/homepage.htm>

University of Virginia Police Department
2304 Ivy Road
Charlottesville, VA 22903
434-924-7166
<http://www.virginia.edu/uvapolice/>

Virginia Institute for Justice Information Systems (VIJIS)
RECAP Program
<http://vijis.sys.virginia.edu>